ROUND ROBIN SCHEDULING ALGORITHM WITH DYNAMIC TIME QUANTUM

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Abstract

The Round Robin(RR) algorithm is the most widely used among various scheduling algorithms. Although it is most optimum for the time-shared systems, time quantum being static, causes low switching context with large time quantum slice and a high switching context with small time quantum slice. Thus, the static time quantum decreases the performance of the round robin algorithm. On referencing the idea from [1], a variance in the time quantum is proposed, a dynamic quantum variance will lead to appropriate calculation of the time quantum for every process as it is in the scheduling queue. Thus, resulting in better process scheduling and improved multitasking.

The main objective of this project is to implement the real time scheduling algorithm and to minimize the average waiting time so that given set of tasks may be completed in a minimal time with an efficient output with the introduction of the dynamic time quantum. Task within the real-time systems are designed to accomplish certain service(s) upon execution, and thus, each task has a significance to the overall functionality of the system. Scheduling algorithms in non-real time system not considering any type of deadline but in real time system deadline is main criteria for scheduling the task.

Proposed Algorithm

The processes in the ready queue are arranged in the ascending order of their remaining burst time. CPU is allocated to the processes using RR scheduling with time quantum value equal to the mean of burst time of all arrived processes in the ready queue. After each cycle processes in the ready queue are arranged in the ascending order of their remaining burst time and CPU is allocated to the processes using RR scheduling with time quantum value equal to the mean of burst time of remaining processes in the ready queue. The steps are as follows:

Step 1: Arrange the processes in the increasing order of CPU burst time in the ready queue.

Step 2: Calculate the Mean of the CPU burst time of all the Processes Mean (M) = (P1+P2+P3…….Pn)/n;

Step 3: Set the dynamic quantum time (DQT) per the following method DQT = M;

Step 4: Allocate all processes to the CPU like present Round Robin scheduling algorithm in the arranged order as in Step1, with time period of Dynamic Time Quantum.

Step 5: If remaining CPU burst time is less than the DTQ, perform the Step2 and Step3 again.

Step 6: Continue till a new process is inserted into the queues, in case repeat all steps from Step1.

Step 7: Process the queue till all processes are executed.

Flowchart Representation :

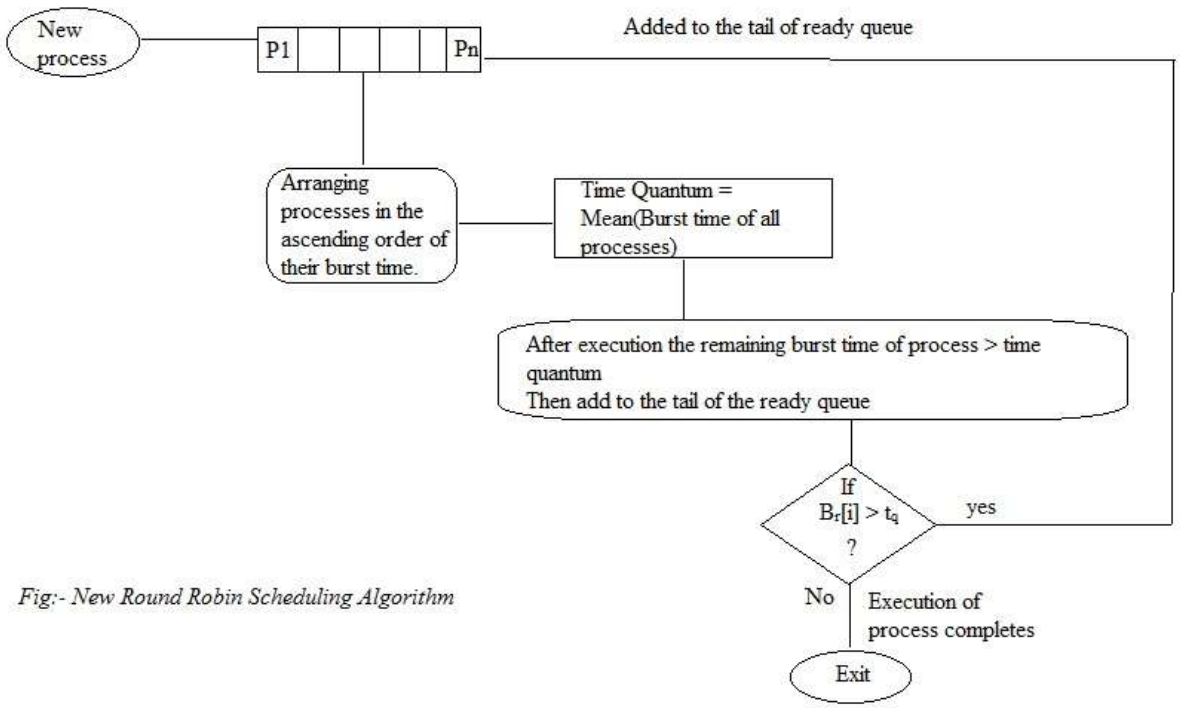


Fig:- New Round Robin Scheduling Algorithm

Implementation Code

```
#include<stdio.h>

//DISPLAYING THE GANTT CHART
void Gantt_chart(int n,int pname[], int Wt[], int Bu[])
{
   int i;
   printf("\n\nGANTT CHART");
   printf("\n---------------------------------------------------------------------\n");
   for(i=0;i<n;i++)
      printf("| \tP%d\t",pname[i]);
   printf("| \t");
   printf("\n---------------------------------------------------------------------\n");
   //printf("\n");
   for(i=0;i<n;i++)
      printf("%d\t\t",Wt[i]);
   printf("%d",Wt[n-1]+Bu[n-1]);
   printf("\n---------------------------------------------------------------------\n");
   printf("\n");
 }

int main()
{
        int i, limit, total = 0, x, counter = 0, time_quantum, y=0, p[10], t, t1=0, pos,Wt[10];
        int wait_time = 0, turnaround_time = 0, arrival_time[10], burst_time[10], temp[10];
        float average_wait_time, average_turnaround_time;
        printf("\nEnter Total Number of Processes:\t");
        scanf("%d", &limit);
        x = limit;
        for(i = 0; i < limit; i++)
        {
                printf("\nEnter Details of Process[%d]\n", i + 1);
                printf("Arrival Time:\t");
                scanf("%d", &arrival_time[i]);
                printf("Burst Time:\t");
                scanf("%d", &burst_time[i]);
        //y = y + burst_time[i];
         p[i]=i+1; //contains process number
        }

        printf("\nProcess ID\t\tBurst Time\t Turnaround Time\t Waiting Time\n");
        for(total = 0, i = 0; x != 0;)
        {
          //sorting burst time in ascending order using selection sort
            for(int k = i; k < limit; k++)
                {
                        pos=k;
                        for(int j=k+1; j < limit; j++)
                        {
                           if(burst_time[j]<burst_time[pos])
```

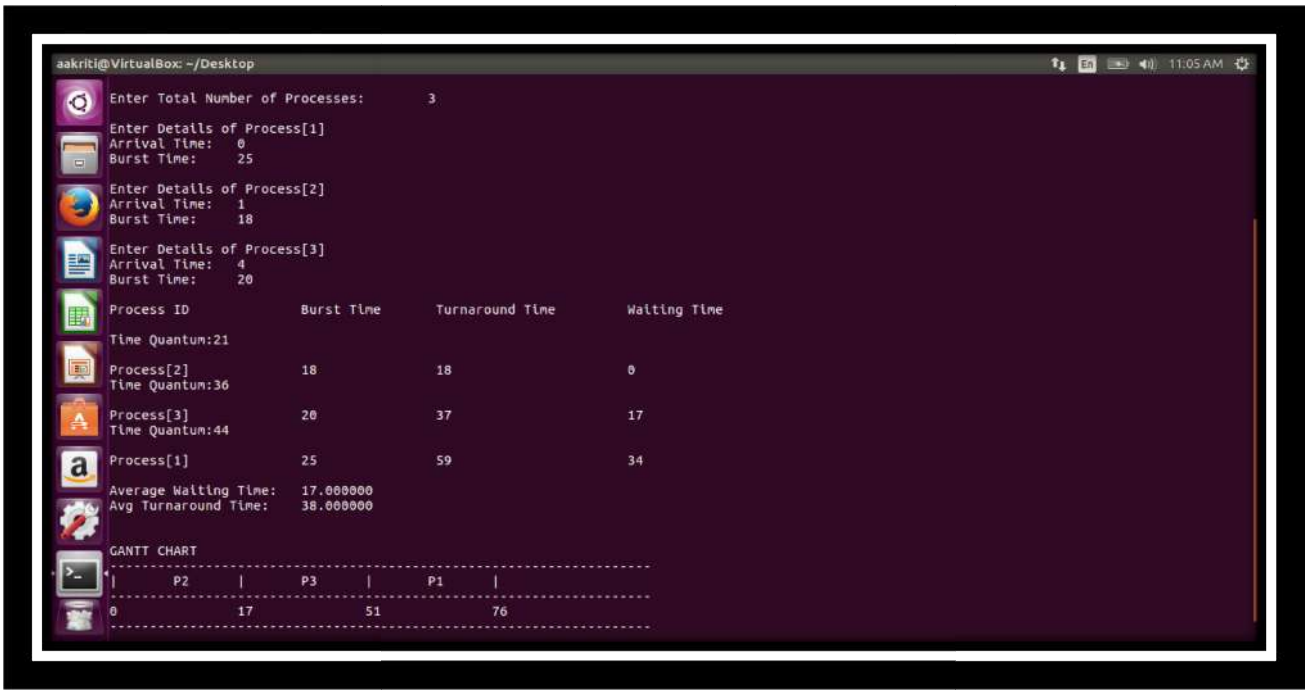
```
                                pos=j;
                        }

                        t=burst_time[k];
                        burst_time[k]=burst_time[pos];
                        burst_time[pos]=t;

                        t1=p[k];
                        p[k]=p[pos];
                        p[pos]=t1;
                }

                for(int k = i; k < limit; k++)
                {  temp[k] = burst_time[k];
                   y = y + burst_time[k];
                 }

//Dynamic Time Quantum is the average of burst time of all arrived process
                time_quantum = y/limit-i;
                printf("\nTime Quantum:%d\t\n", time_quantum);

                if(temp[i] <= time_quantum && temp[i] > 0)
                {
                        total = total + temp[i];
                        temp[i] = 0;
                        counter = 1;
                }
                else if(temp[i] > 0)
                {
                        temp[i] = temp[i] - time_quantum;
                        total = total + time_quantum;
                }
                if(temp[i] == 0 && counter == 1)
                {
                        x--;
                        printf("\nProcess[%d]\t\t%d\t\t  %d\t\t\t  %d", p[i], burst_time[i],
total - arrival_time[i], total - arrival_time[i] - burst_time[i]);
                        wait_time = wait_time + total - arrival_time[i] - burst_time[i];
            Wt[i]=wait_time;
                        turnaround_time = turnaround_time + total - arrival_time[i];
                        counter = 0;
                }
                if(i == limit - 1)
                {
                        i = 0;
                }
                else if(arrival_time[i + 1] <= total)
                {
                        i++;
                }
                else
```

```
                {
                        i = 0;
                }
        }
        average_wait_time = wait_time * 1.0 / limit;
        average_turnaround_time = turnaround_time * 1.0 / limit;
        printf("\n\nAverage Waiting Time:\t%f", average_wait_time);
        printf("\nAvg Turnaround Time:\t%f\n", average_turnaround_time);
    Gantt_chart(limit, p, Wt, burst_time);
        return 0;
}
```

OUTPUT

```
aakriti@VirtualBox:~/Desktop$ ./a.out

Enter Total Number of Processes:    4

Enter Details of Process[1]
Arrival Time:  0
Burst Time:    18

Enter Details of Process[2]
Arrival Time:  1
Burst Time:    20

Enter Details of Process[3]
Arrival Time:  3
Burst Time:    24

Enter Details of Process[4]
Arrival Time:  4
Burst Time:    60

Process ID            Burst Time      Turnaround Time       Waiting Time

Time Quantum:30

Process[1]            18              18                    0
Time Quantum:34

Process[2]            20              37                    17
Time Quantum:42

Process[3]            24              59                    35
Time Quantum:60

Process[4]            60              118                   58

Average Waiting Time: 27.500000
Avg Turnaround Time:  58.000000


GANTT CHART
-------------------------------------------------------------------
|      P1     |      P2     |      P3     |      P4     |
-------------------------------------------------------------------
0             17            52            110           170
-------------------------------------------------------------------
```

Screenshot :



Graphs :

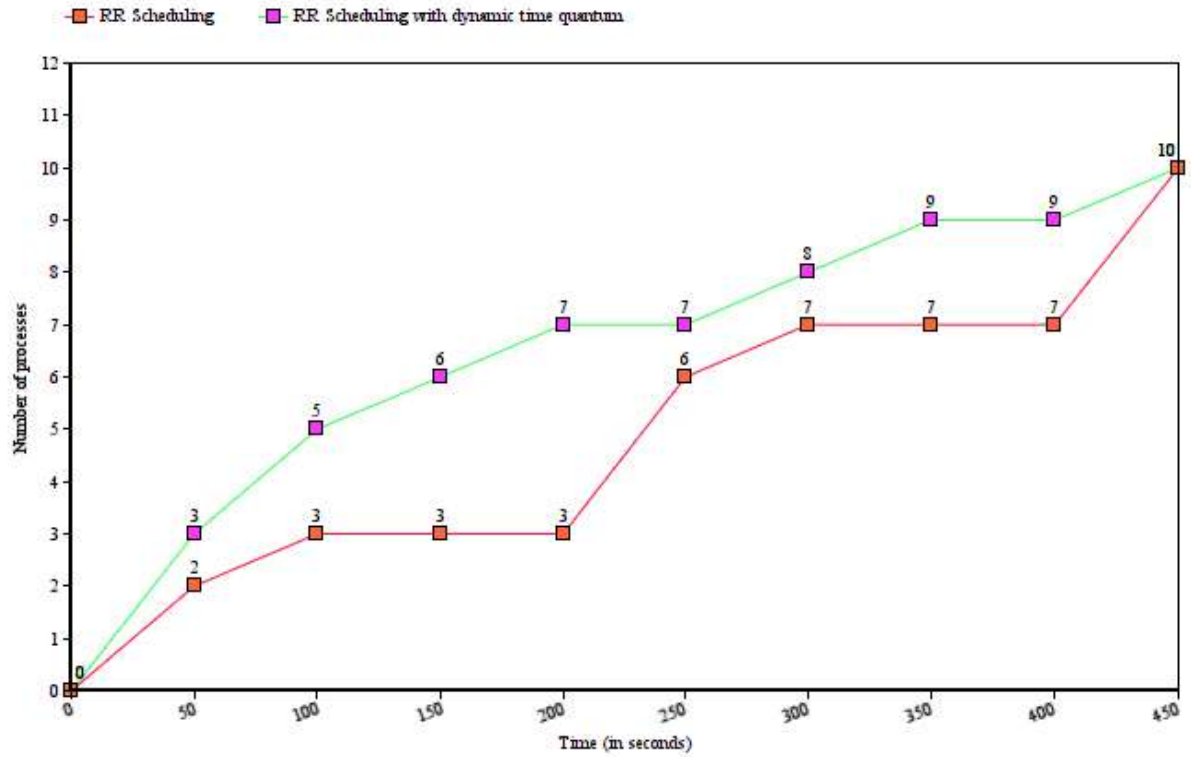
The graphs below compares RR_{old} and RR_{new} scheduling algorithms based on turnaround time, waiting time and average times for 10 processes.

Graph 1 represents the CPU utilisation by each algorithm considering the number of processes executes completely with respect to the turnaround time.

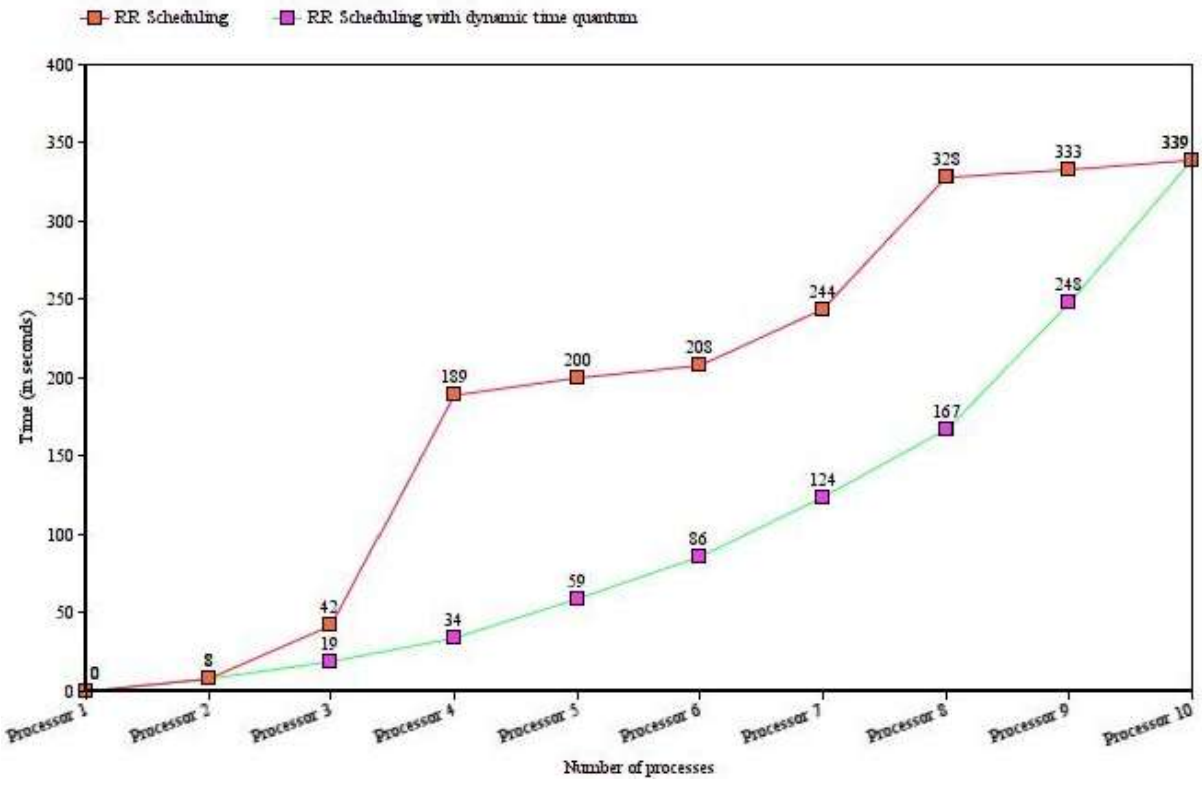
Graph 2 represents the waiting time for each processor before execution to complete for the two algorithms.

Graph 3 compares the average waiting time and average turnaround time of each of the algorithms.

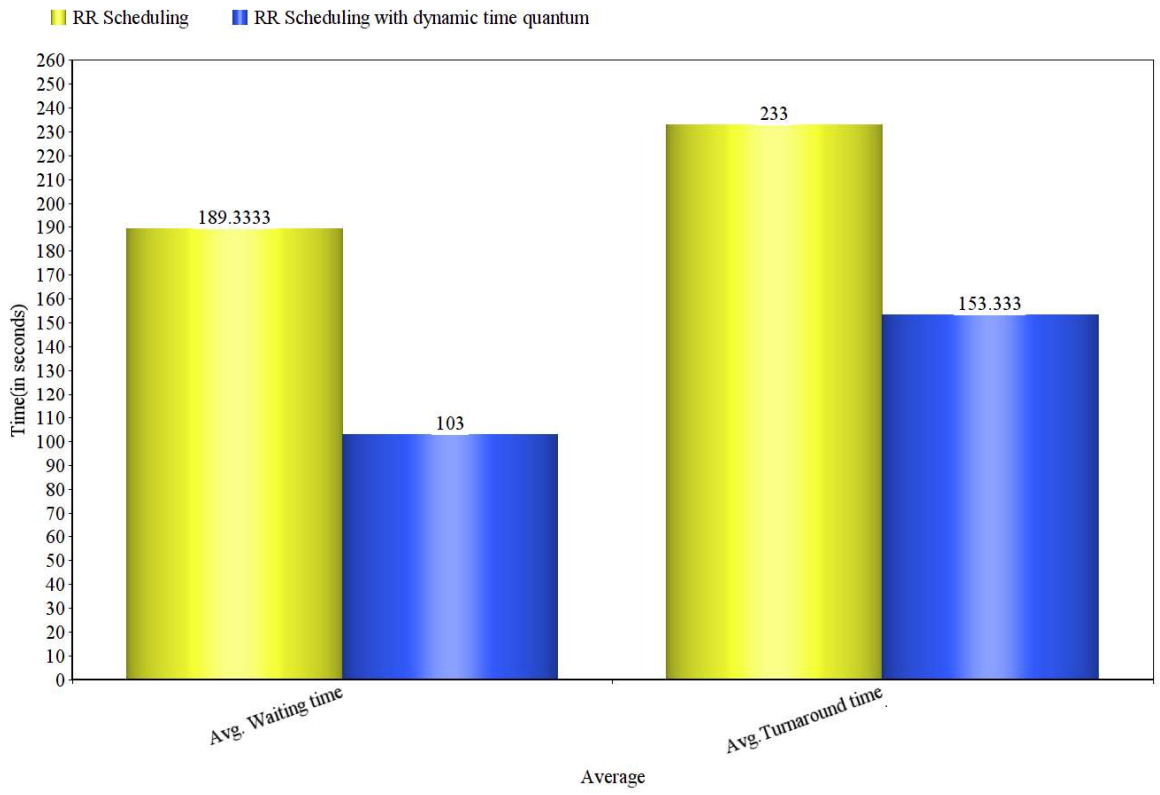
The red line indicates the working of RR_{old} scheduling algorithm and green line indicates the RR_{new} scheduling algorithm.



Graph 1: **CPU Utilisation time(Turnaround Time)**



Graph 2: **Waiting Time of each Processor**



Graph 3: **Performance Analysis**

CONCLUSION

The improved round robin scheduling algorithm with varying quantum time shows better scheduling performance results in the graphs compared to the existing round robin scheduling algorithm. In graph 1, the rate of CPU utilization of new algorithm is higher than the old algorithm within a time range. The processes gets executed to complete with minimum waiting time during scheduling by new algorithm. The performance analysis of new algorithm is far better than the old algorithm. This algorithm can be used for CPU scheduling in the future systems.

BIBLIOGRAPHY

[1] Aakriti Upadhyay and Siddheshwar Kanagamoorthy, "*Improved Round Robin CPU Scheduling Algorithm with Dynamic Time Quantum*", Paper 1 of the Operating Systems Class SUNY ALBANY, October 2016.

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